Space Weather Forecast

Issued on Thursday, 20 July 2023 at 13:21 Local

This forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Minor/Moderate R1/R2 radio blackouts likely throughout. Chance of G1/G2 (Minor/Moderate Storms) to end UTC week. Reducing chance of further S1 (Minor Solar Radiation Storm) periods.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate in the past 24 hours, peaking at a mid-ranking Moderate-class X-ray flare at 19/1725UTC from a large and complex sunspot region, now-departed over the southwestern solar horizon. The departure of this sunspot group heralded a change in character of the observed X-ray trace at the observing satellite(s), with previously frequent low-level Common-class flares interspersed with isolated moderate activity - instead falling to a stable flat trace by the end of the reporting period.

There were up to eight sunspot regions on the Sun in the period - well-scattered across much of the facing side. The Sun shows numerous large and nominally magnetically complex regions, with perhaps the most notable being one near the central portion of the Sun, with slight proliferation in its leading spots observed. In addition to this, there was slight proliferation of small trailing spots in two other groups, otherwise remaining spots were relatively stable.

Figure 1: SIDC ROB-derived view of the central swathe of the Sun showing the emission locations of all X-ray flares of Common-class and above in the past 72 hours. The southwestern solar horizon cluster is due to the now departed large sunspot, and the disappearance of this region is the rationale for the initial slight dip in daily X-ray flare risk.

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A Coronal Mass Ejection (CME) was observed leaving the western horizon of the Sun in association with the Moderate-class flare - this has been modelled, and although a minority of model ensemble members show narrow glancing incidence of this CME in the UTC day of 23 July, these hits are considered improbable, and this feature is instead thought a likely miss to no effect. No other Earth-directed CMEs were observed in the available imagery.

Solar Wind / Geomagnetic Activity: Solar wind parameters showed a stable slow wind regime. The solar wind speed showed a very slight slowing tendency, falling from slightly elevated to background levels. The number of particles in the solar wind was at background, while their associated magnetic field was steady, within normal parameters and with a small-scale north-south component (co- or anti-aligned with Earth's field to lesser or greater effect respectively). The net result of the above solar wind measures was for provisionally quiet indices throughout.

Energetic Particles / Solar Radiation: Solar radiation levels showed a continuing gradual relaxation in the period, falling through the 10pfu S1 Minor Solar Radiation Storm threshold in moving from 36pfu to 7 in the current period, having earlier peaked at 620pfu (S2, Moderate Solar Radiation Storm) in the immediate aftermath of the causative Moderate-class X-ray flare that occurred 18/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Activity carries a chance of returning to Moderate over the following days, with a chance of isolated Moderate-class X-ray flares and a slight chance of Strong flares. The character of the observed X-ray trace has changed as the recent large active sunspot group has left the facing side (i.e. it has become quieter), and a tentatively identified new lower level of risk may now again rise day-on-day with progressive far-side arrivals in the four-day period.

Solar Wind / Geomagnetic Activity: The geomagnetic forecast is relatively low confidence to end the current week especially. This is both for the presence of up to two possibly Earth-directed CMEs - one of which is now overdue - but also because of the tenuous but probably inconsequential fast wind-emitting coronal hole arrangement. There remains a chance of Minor/Moderate Geomagnetic storm G1/G2 to end the UTC working week, although the chances of Moderate geomagnetic activity, especially, are now considered slightly lower for the overdue first CME. Thoughts on the second CME remain unchanged, and this is overlaid over uncertain but likely minor coronal hole influence.

Geomagnetic activity should become more reliably quiet by the end of the coming UTC weekend, barring new CME-producing events.

Energetic Particles / Solar Radiation: Solar radiation has recently crossed the Minor Solar Radiation Storm S1 threshold on a downward trajectory, having earlier reached a peak within S2 (Moderate) at 18/0620UTC. The chances of further such occurrences are held higher in the near-term for the presence of the causative large sunspot narrowly over the best-connecting (with Earth) western solar horizon, but also because of the high starting point, meaning relatively little further addition is needed for S1 at least.

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Geomagnetic Storms:

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	30	10	1
Strong	G3	No	1	10	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Radio Blackouts - X Ray Flares:

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	50	50	60	60
Very Active	R3 to R5 X	No	5	5	10	10

Solar Radiation Storms - (High Energy Protons):

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	Yes	50	30	20	15
Very Active	≥ S3 *	No	5	5	5	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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